NAVSHIPS_____

Temporary Instruction Book

NAVY TYPE ACB

1600-AMPERE FRAME SIZE

AIR CIRCUIT BREAKER

WESTINGHOUSE TYPE DBN-60S

S. O. 19-Y-3846

SERIAL NOS. 1-19-Y-3846 THROUGH 96-19-Y-3846

NAVY CONTRACT NObs 50267

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WESTINGHOUSE ELECTRIC CORPORATION
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INDEX

AIR CIRCUIT BREAKER
Navy Type ACB (Westinghouse Type DBN 60S)
1600 Amp. Frame Size
50,000 Amp. D-c Interrupting Capacity
Westinghouse Electric Corp. Dwg. 1-JH-232
Buships Plan S6202-3,004,998

Description	Page
SECTION A - INTRODUCTION	1
List of Illustrations	1
SECTION B - GENERAL INFORMATION	3
General	3
Overcurrent Trip Device	3
Construction	3
Operating Mechanism	3
Electric Operation	3
Remote Manual Trip	3
Mounting	3
SECTION C - OPERATION AND MAINTENANCE	4
Caution	4
Control Voltage	4
Calibration	4
Maintenance	4
SECTION D - COMPONENTS AND ATTACHMENTS	5
Arc Chutes	5
Contact Assembly	5
Mechanism	7
Anti-Shock-Close Device	9
The Closing Magnet (Solenoid)	11
The Close Coil Contactor	11
Anti-Shock-Open Device	14
Series Overcurrent Trip Device	16
Auxiliary Switch	19
Shunt Trip Device	19
Spare Parts List	22

NAVY TYPE ACB AIR CIRCUIT BREAKER
Westinghouse Type DBN-60S

SECTION A—INTRODUCTION
List of Illustrations and Calibration Curves

FIG NO.	Westinghouse Ref. Dwg.	TITLE	PAGE
1	32-A-6816	General Assembly	2
2	32-A-6814	Pole Unit	6
3	32-A-6815	Mechanism	8
4	32-A-6820	Closing Magnet and Anti-Shock Close Device	10
5	32-A-6818	Close Coil Contactor	12
6	22-B-7154	Anti-Shock Open Device	15
7	32-A-6817	Series Overcurrent Trip Device	17
8	351880	Time vs Current Calibration Curve	18
9	32-A-6819	Auxiliary Switch	20
10	22-B-7588	Shunt Trip Device	21

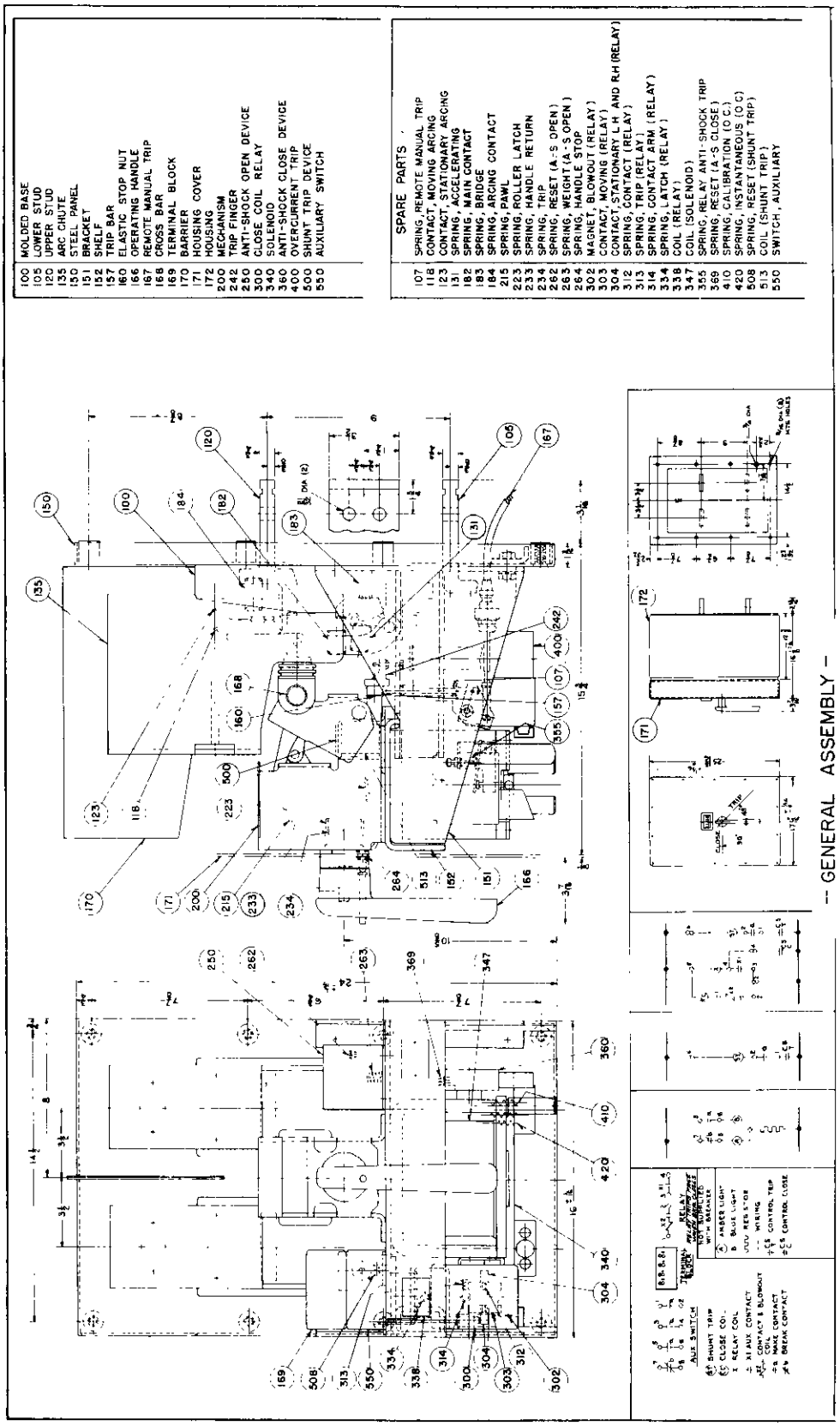


Figure 1 — General Assembly

SECTION B—GENERAL INFORMATION

GENERAL

The DBN-60S air circuit breaker is a sturdy, compact piece of shipboard electrical equipment consisting of a rigid steel chassis to which are bolted the several sub-assemblies which make up the complete circuit breaker. For example, the mechanism, pole units, arc chutes, overcurrent trip devices and other attachments are each complete within themselves and are readily interchangeable between breakers. They may be removed intact and replaced if necessary with minimum outage time.

The DBN-60S is a modified type ACB air circuit breaker of 1600 ampere frame size. It is a two pole direct current breaker with a continuous current rating of 2600 amperes and a short time rating of 7000 amperes for 30 minutes. The interrupting rating of the circuit breaker is 50,000 maximum d-c amperes at 500 volts on two poles or at 355 volts on a single pole.

OVERCURRENT TRIP DEVICES

The overcurrent tripping devices are calibrated to pick up and trip the circuit breaker after a short time delay period at currents above 8500 amperes and below 30,000 amperes. At currents above 30,000 amperes, the overcurrent tripping devices will pick up and trip the circuit breaker instantaneously.

CONSTRUCTION

The DBN-60S air circuit breaker consists of a rigid steel panel (150) Fig. 1 on the front of which is bolted a supporting frame consisting of a bracket (151) which in turn supports shelf (152). A separate molded pole unit base (100) is bolted to the steel panel for each pole. The base of each pole unit is molded from insulating material. The series overcurrent trip devices (400) are bolted to the lower part of the pole unit base. The moving contact assembly is pivoted at its lower end on the pole unit base and is connected to the lower stud through the series coil of the overcurrent trip device. The stationary contact assembly is connected directly to the upper stud. The moving contact assembly opens and closes the electric circuit by moving out and in from the stationary contact assembly. An arc chute is mounted above and surrounding each pair of contacts. Its purpose is to stretch and cool the arc drawn when the contacts separate so that it may be readily extinguished.

OPERATING MECHANISM

The operating mechanism (200) is located on the breaker shelf (152) and transmits the force for closing the breaker from the operating handle (166) to the cross bar (168) and thence to the moving contact assembly through insulating links. The mechanism then latches and holds the contacts in the closed position. The circuit breaker is closed manually by depressing button in operating handle (166) and then turning the operating handle 90^{o} clockwise. It may be tripped manually by turning the handle 45^{o} in the opposite direction. Automatic tripping is accomplished by one of the automatic devices which lift the trip bar (157) when suitably energized. These devices consist of the shunt trip (500) and the series overcurrent trips (400). Auxiliary switch (550) and a terminal block (169) are supplied for auxiliary circuits to be controlled by the operation of the circuit breaker.

ELECTRIC OPERATION

The circuit breaker is electrically operated by a closing magnet or solenoid (340). A closing coil contactor or relay (300) makes and interrupts the closing magnet circuit. These two attachments plus a control switch and shunt trip device enable the operator to open and close the circuit breaker electrically from a remote point.

REMOTE MANUAL TRIP

In addition to the automatic tripping features outlined above and the manual trip provided by counterclockwise rotation of the handle, a remote manual trip (167) is supplied which enables an operator to trip the circuit breaker manually from a remote point. Pulling on the flexible cable actuates linkages inside the circuit breaker which lift the trip bar and trip the breaker.

MOUNTING

The circuit breaker is mounted in a steel housing (172) which is fitted with a bolted-on

cover (171) in which a transparent window enables the operator to see the position indicator which indicates whether the breaker is open or closed. The general assembly Fig. 1 shows the drilling plan and stud location.

The eight 9/16" diameter mounting holes are tapped for the mounting bolts. These eight mounting bolts go through the back of the housing and into the tapped holes in the steel panel 150 of the circuit breaker. Two additional bolts through the housing cover on the circuit breaker center line hold the circuit breaker in the housing when the housing is removed from its mounting.

* * * * * *

SECTION C—OPERATION AND MAINTENANCE

CAUTION

Before working on a circuit breaker, load and control circuits feeding it must be de-energized. The breaker should be in the open position, but it should be noted that all circuit breaker studs are not necessarily dead when circuit breaker is open.

Before putting the circuit breaker in regular operation it should be closed and tripped manually several times to see whether all parts are in proper alignment and move freely. Particular care should be taken to make sure the studs have not been forced out of alignment by the bus work. Lift the trip bar by hand with the circuit breaker open to make sure that it does not bind.

Fig. 1 shows the drilling plan and wiring diagrams of the DBN-60S. Reference is made to the other sections in this book on the closing magnet and the close coil contactor for an explanation of the part these devices play in the operation of an electrically operated circuit breaker.

CONTROL VOLTAGE

The closing magnet, the close coil contactor, and the shunt trip device operate on a voltage range of 175 to 355 volts.

CALIBRATION

The overcurrent trip devices are calibrated at the factory to trip the circuit breaker at currents greater than 8500 amperes. This calibration point is marked on the scale plate. This calibration may be changed by turning the insulated knob on the overcurrent trip device. Moving the indicator up decreases the pickup current and moving it down increases the pickup current. Reference is made to Fig. 8 which shows the Time vs Current characteristic of the overcurrent trip device.

MAINTENANCE

The frequency of inspection for maintenance will depend upon local conditions but, in general, a complete inspection for preventive maintenance should be made at least once a year. It is recommended that a special inspection be given any breaker that has opened a heavy short-circuit current.

If excessive heating not caused by overcurrent is observed, look for loose or corroded contacts or connections.

When inspecting the circuit breaker, examine the contact surfaces. Rough or high spots should be removed with a clean file or sandpaper. Do not use emery cloth since the dust from this material is a good conductor of electricity and is sure to cause trouble if allowed to settle on insulating surfaces.

Arc chutes which are badly burned and corroded should be replaced.

More detailed maintenance instructions are given later on in the sections on the individual attachments.

SECTION D—COMPONENTS AND ATTACHMENTS

D-1. ARC CHUTES

Reference Figure 2

FUNCTION

The arc chute (135) Fig. 2 mounted above and surrounding the contact assembly of each pole, has the function of stretching and cooling the arc drawn by the separating contacts so that it may be quickly extinguished and the circuit opened in the least possible time. The arc chutes are an extremely important part of the circuit breaker and the breaker should never be energized without their being mounted in place.

DESCRIPTION

Each arc chute consists of a number of metal and asbestos plates supported in a laminated case and held in place by a clamping plate (136) and insulating tube spacers (146) and two screws (147) through the insulating spacers to the molded base (100). When the arc is drawn by the separating contacts, it moves up into the chute by magnetic and thermal action where it is quickly de-ionized and extinguished thus opening the circuit.

REPLACEMENTS

When inspection shows that the plates of the arc chute are badly burned it should be replaced by removing screws (147).

D-2. CONTACT ASSEMBLY

Reference Figure 2

FUNCTION

The contact assembly closes and opens the electric circuit through the circuit breaker. See Fig. 2. The upper stud (120), the stationary contact (121), the series overcurrent trip device (400) and the lower stud (105) are stationary and are mounted rigidly on the molded base (100). The moving contact assembly is hinged on the molded base by pin (127) and is moved in and out by molded insulating link (116) which is pivoted on cross bar (168) Fig. 1.

The moving contact assembly is closed and held in the closed position against the force of the accelerating springs (131) by the insulating link (116). When the force exerted by the insulating link is released by tripping the breaker, the accelerating spring quickly moves the moving contact assembly to the open position. When the breaker interrupts high short circuit currents, magnetic forces play a large part in the rapid opening of the contacts.

When the main contacts open the moving contact assembly moves away, drawing the arc between the arcing contacts. This arrangement minimizes arc damage to main current carrying contacts. When the circuit breaker is closed the arcing contact surfaces touch first and then the main contacts touch and the closing operation is completed.

DESCRIPTION

The stationary contact assembly consists of the main contact extruded integral with the upper stud (120) and the arcing contact (123). Contact surfaces of (121) and (123) are special arc-resisting silver alloy inserts.

The moving contact assembly consists of a contact arm (175) which is pivoted to the pole unit by pin (127) and which carries main moving contact (109) and moving arcing contact (118). Auxiliary contact (176) serves as a bridge between main moving contact and connector to the upper terminal of the series coil of the overcurrent tripping device.

The moving contact assembly is attached to the mechanism cross bar (168) Fig. 1 by molded insulating link (116) which is screwed on metal link (111) and locked by nut (114). When the breaker is tripped all force is removed from the cross bar and accelerating springs (131) quickly snap the moving contact assembly from the closed to the open position.

REPLACEMENTS

To replace stationary arcing contact (123) or spring (184):

(a) Remove arc chute (135) by removing screws (147).

100	MOLDED BASE	
105	LOWER STUD	
108	SHUNT	
109	MAIN MOVING CONTACT ASSEMBLY	
111	LINK	
112	5/16-18 X 1/2 HEX. STL. BOLT	
114	5/16-18 BRS. LOCKNUT	
115	PIN	
116	MOLDED LINK	
* 118	CONTACT, MOVING ARCING	
120	UPPER STUD ASSEMBLY	
121	STATIONARY CONTACT	
* 123	CONTACT, STATIONARY ARCING	
127	PIN	
129	1/2-13 X 1 1/2 HEX. STL BOLT	
135	ARC CHUTE	
136	CLAMPING PLATE	
146	TUBE SPACER	
147	5/16-18 X 8 1/4 PAN HD. STL SCREW	
148	1/4-20 HEADLESS SET SCREW	
149	1/4-20 GALV. STL. LOCKNUT	
158	CONTACT SHIELD	
159	ARCING CONTACT HINGE	
173	PIN	
174	MOVING CONTACT ARM HINGE	
175	MOVING CONTACT ARM	
176	AUXILIARY CONTACT	
179	1/4-20 X 1/2 HEX. STL BOLT	
180	SHUNT CLIP	
181	1/2-13 X 2 1/2 HEX STL. BOLT	
* 182	SPRING, MAIN CONTACT	
* 183	SPRING, BRIDGE	
* 184	SPRING, ARCING CONTACT	
* 400	OVERCURRENT TRIP	
* 131	SPRING, ACCELERATING	
451	BOLT, 1/2-13 X 2 1/2 HEX. STL	
478	BOLT, 1/2-13 X 2 1/2 HEX STL.	

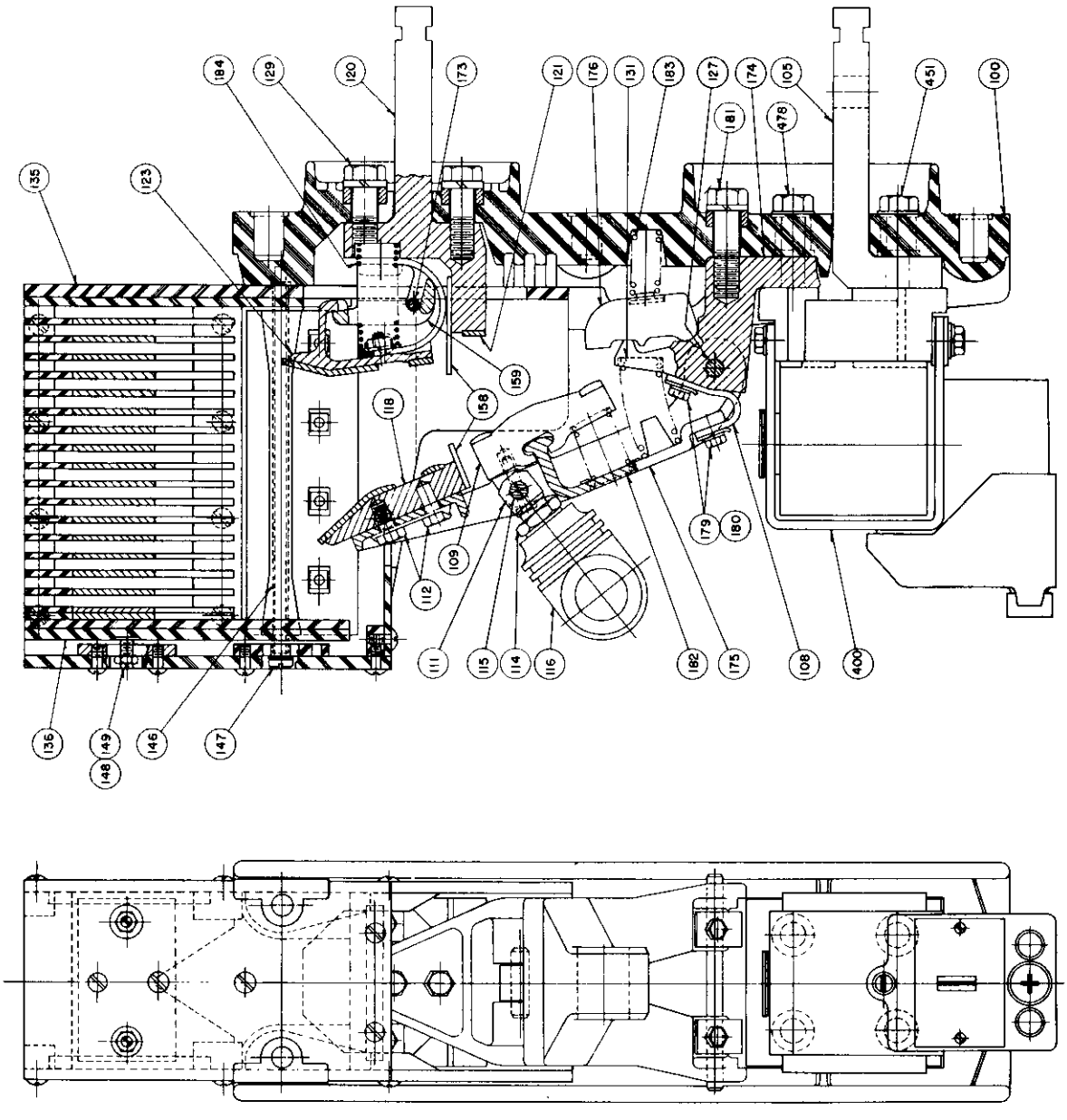


Figure 2—Pole Unit

(b) Remove the two bolts holding the contact assembly and replace either it or the spring as required.

To replace moving arcing contact (118):

(a) Remove arc chute (135) by removing screws (147).
(b) Removal of bolts (112) frees the contact for replacement.

To replace main contact springs (182):

(a) Remove arc chute as before.
(b) Springs are held by locking clips in contact arm (175). These clips release the springs when rotated with a screwdriver or with the fingers.

To replace accelerating springs (131):

(a) Remove arc chute as before.
(b) Springs may be worked out of their sockets with a screwdriver.

To replace bridge springs (183):

(a) Remove arc chute as before.
(b) Springs may be worked out and replaced with a screwdriver. If difficulty is experienced, loosen moving contact arm hinge by loosening bolts in vicinity of lower stud holding overcurrent trip and contact arm hinge.

D-3. MECHANISM

Reference Figure 3

FUNCTION

The operating mechanism opens and closes the circuit breaker contacts by moving the cross bar (168) Fig. 1 to which the moving contact assemblies are attached by insulating links. The DBN-60S is closed manually by turning the operating handle quickly and smoothly as far as it will go (90^{o}) in a clockwise direction. The breaker may be tripped manually by turning the handle 45^{o} in a counterclockwise direction. Button in handle must be held in while closing or tripping. The breaker is tripped automatically by one of the automatic devices described later which rotate trip lever (220) about pin (224). See Fig. 3.

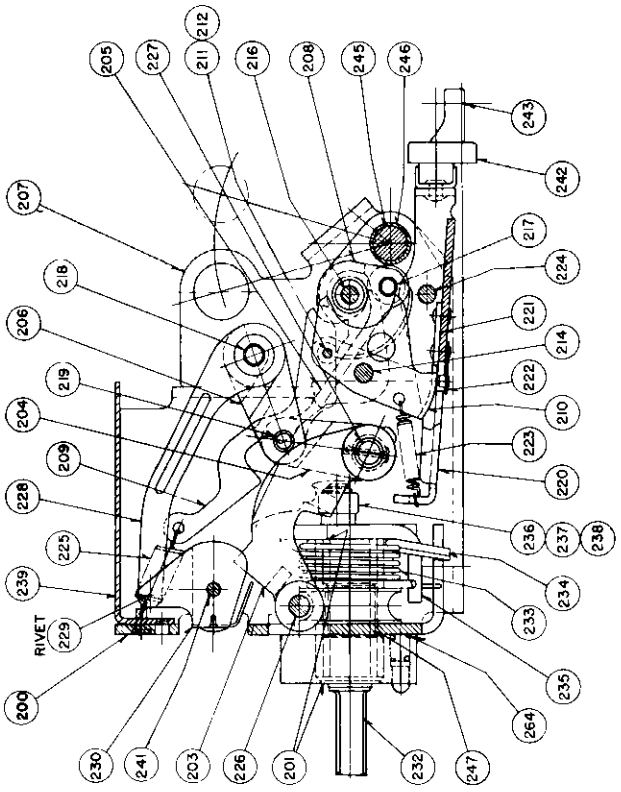
The mechanism is "trip free", that is, it is not possible to close the breaker if one of the automatic tripping devices moves the trip bar up during the closing stroke or if the trip bar is held in the raised position.

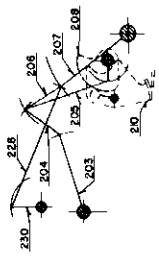
DESCRIPTION

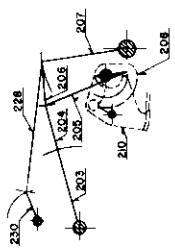
The operating mechanism consists of a group of toggle links, and a latch attached to the operating mechanism frame on fixed pins (214), (226), (241), (216), (224) and (245). The cross bar (168) is held by the closing lever (207). Rotating the operating handle clockwise moves the mechanism linkage from the open position shown in Fig. 3 to the closed position shown. This is accomplished when the roller (236) located off-center on the end of the operating handle shaft (232) forces the first toggle link (203) upward pushing second toggle link (204), third toggle link (206) and closing lever (207) ahead of it. The motion of the toggle linkages is directed by link (205) which is pivoted at its lower end on pin (217) in latch (208). Latch (208) in turn is restrained from moving by roller latch (210) which is pivoted on pin (214) and engages trigger (221), on trip lever (220). The linkage is held in the closed position by pawl (209) which latches under pin (227). The handle shaft and lever are returned to the normal position after closing by handle return spring (233).

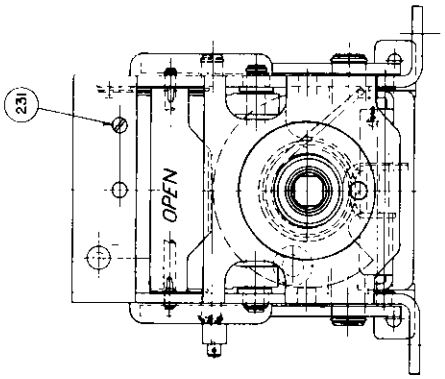
The mechanism is opened by rotating trip lever (220) counterclockwise. This is accomplished either by rotating handle counterclockwise, in which case roller (236) on the end of handle shaft lever strikes the extreme left end of trip lever (220) to move it downward; or by causing tripping attachments to strike trip finger screw (243) or trip bar. In either case the counterclockwise rotation of the trip lever (220) moves trigger (221) out of engagement with the lower end of the roller latch (210), which in turn permits the roller latch to rotate counterclockwise out of engagement with latch (208). Latch (208) is then free to rotate in response to the pull of the latch link (205) so that the mechanism assumes the trip free position shown in Fig. 3 in which the contacts are open but part of the mechanism levers are in the closed position. In this position pawl (209) is disengaged from pin (227) by a lug on link (204) which pushes it up permitting the linkage to collapse to the open position shown in Figure 3.

200	FRAME, MECHANISM	
201	BEARING, ROLLER	
203	LINK, FIRST TOGGLE	
204	LINK, SECOND TOGGLE	
205	LINK	
206	LINK, THIRD TOGGLE	
207	LEVER, CLOSING	
208	LATCH	
209	PAWL	
210	LATCH, ROLLER	
211	ROLLER	
212	PIN	
214	PIN	
216	PIN	
217	PIN	
218	PIN	
219	PIN	
220	LEVER, TRIP	
221	TRIGGER	
222	STOP, SPRING	
* 223	SPRING, ROLLER LATCH	
224	PIN	
* 225	SPRING, PAWL	
226	PIN	
227	PIN	
228	LINK, INDICATOR	
229	PIN	
230	INDICATOR	
231	SCREW, 1/4-32 X 3/8 PAN HD.	
232	SHAFT	
* 233	SPRING, HANDLE RETURN	
* 234	SPRING, TRIP	
235	LEVER	
236	ROLLER	
237	BEARING, NEEDLE	
238	PIN	
239	COVER	
241	PIN	
242	FINGER, TRIP	
243	SCREW	
245	PIN	
246	SPACER	
247	SPACER	
* 264	SPRING, HANDLE STOP	









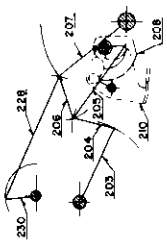


Figure 3 — Mechanism

Trip spring (234) returns operating handle to the normal vertical position after manual tripping. It is made considerably stronger than otherwise necessary in order to prevent tripping of the breaker by accidental flipping of the handle.

POSITION INDICATOR

Position indicator (230) is formed from sheet metal and is pivoted on pin (241). It is visible from the front of the circuit breaker through a window in the housing and mechanism frame. See Fig. 1. With the circuit breaker in the open position shown in Fig. 3, the yellow face of the indicator shows through the window. The word "OPEN" is stamped on this yellow face. When the breaker closes, pin (218) of the closing lever (207) pulls indicator link (228) to the right, thus rotating the other face of the indicator up into a position visible through the window. This face is painted blue and is stamped with the word "CLOSED".

REPLACEMENTS

To replace roller latch spring (223):

(a) Rotate handle (166) clockwise until pin (227) is visible through the right side of mechanism frame. Using a small rod as a pusher, shove this pin part way through the hole until the operating rod of the closing magnet drops off. Return pin (227) to its proper location and allow the linkages to fall open. This frees the mechanism from the closing magnet.
(b) Remove crossbar (168) Fig. 1. Remove the four bolts which hold mechanism to the shelf (152) Fig. 1. This frees mechanism from shelf but frees also the closing magnet. This should be either replaced or blocked in place during repairs to the mechanism.
(c) Removal of pin (224) trip lever (220) to be removed and spring (223) may then be replaced.

To replace trip spring (234) or handle return spring (234):

(a) Repeat (a) through (c) above.
(b) Remove pin (214) and drop pawl (209) and roller latch (210) out of frame.
(c) Remove bearing (201) and push handle shaft back into mechanism frame. Spring (233) or (234) may then be replaced.

To replace handle stop spring (264):

(a) Remove handle.
(b) Remove front roller bearing (201). This frees spring (264) for replacement.

To replace pawl spring (225):

(a) This spring may be replaced without further ado after removing mechanism cover (239).

D-4. ANTI-SHOCK-CLOSE DEVICE

Reference Figure 4

FUNCTION

This device serves to prevent the circuit breaker contacts from closing from shock when open. This is accomplished by an arrangement whereby a mechanical escapement device or "ticker" is operated by the closing of the breaker. Shock blows tending to close the breaker are of such short duration that the mechanical escapement device does not have time to operate and the device effectively locks the open circuit breaker in the open position under shock conditions.

DESCRIPTION

The anti-shock-close device consists of a ticker case (360) Fig. 4 which contains the ticker assembly, bolted to the closing magnet. Arm (374) is bolted to the moving core of the closing magnet and when the moving core moves up, cam (361) is caused to rotate in a clockwise direction around pin (370) against the torsion of return spring (369). As the cam rotates in this manner, oscillator wheel (362) is caused to rotate clockwise around pin (372) by pin (368) mounted in cam (361). The rotation of wheel (362) is regulated by mechanical oscillator (364) which is pivoted on pin (365). This oscillator oscillates due to the engagement of its teeth with the teeth of oscillator wheel (362). When the circuit breaker is tripped, rod (363) drops unimpeded and return spring (369) returns cam and consequently oscillator wheel to the "breaker open" position shown in the figure.

Shock blows tending to close the circuit breaker would have to act in such a way as to raise rod

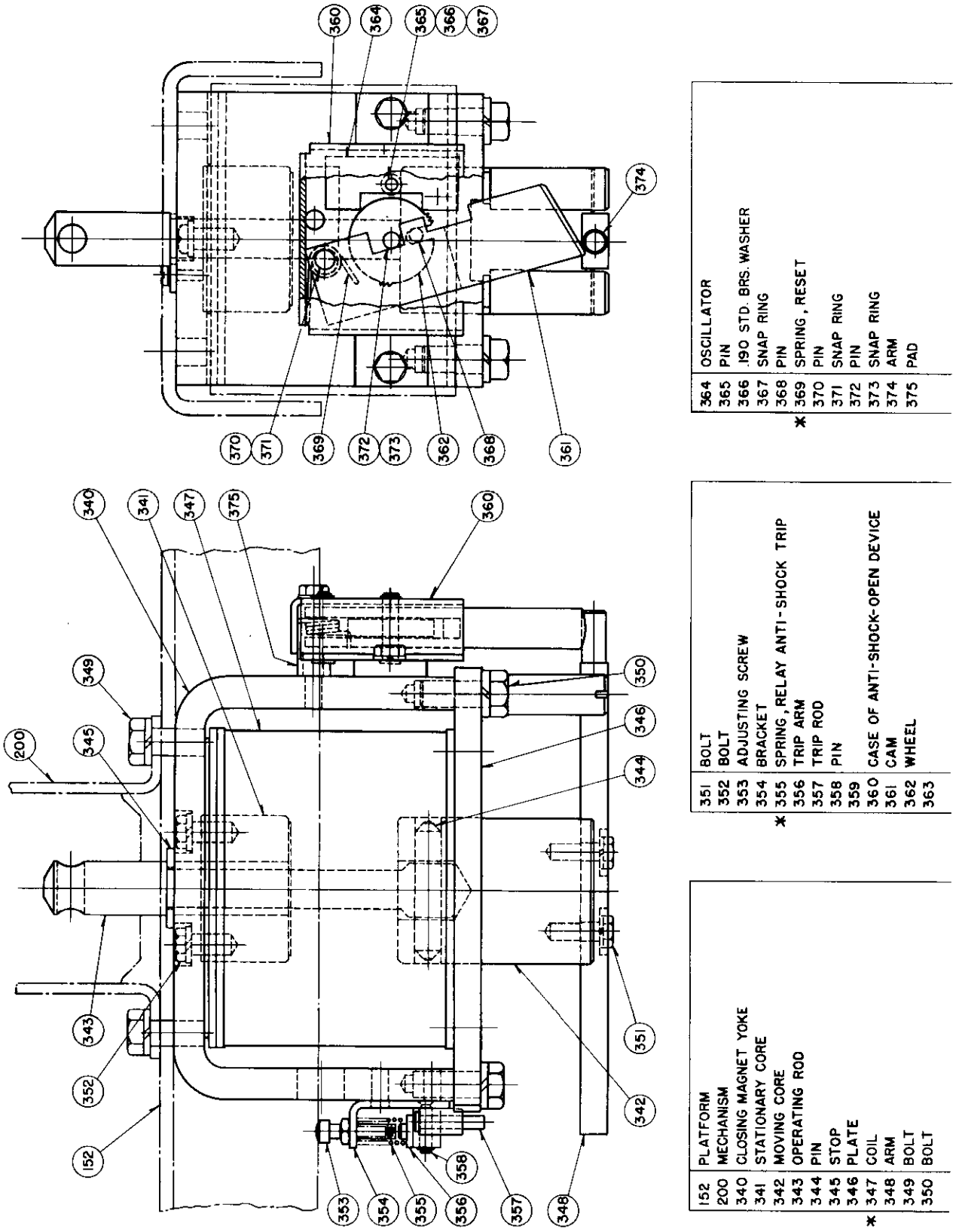


Figure 4 — Closing Magnet and Anti-Shock-Close Device

(363). These blows are of such short duration that the cam is restrained long enough by the oscillator wheel and oscillator to prevent closure of the circuit breaker.

REPLACEMENTS

To replace return spring (369):

(a) Remove device from closing magnet yoke (340) by removing bolts.
(b) Removing snap rings (367), (371), and (373) will allow corresponding pint to be removed. The various parts are then free to be removed and the spring may be replaced.
(c) After reassembly, be sure that the cam operates freely and that it returns freely to its starting position when pushed over.

D-5. THE CLOSING MAGNET (SOLENOID)

Reference Figure 4

FUNCTION

The closing magnet is the device used to close the circuit breaker electrically and is mounted directly below the mechanism and under the shelf of the circuit breaker. It is secured to the shelf with the same four bolts that hold the mechanism in place.

Together with a control switch, a source of power, and the closing coil contactor, the closing magnet enables an operator to close the circuit breaker from a remote point.

DESCRIPTION

The closing magnet Fig. 4 consists of an iron frame or yoke (340) which is securely bolted to the circuit breaker shelf, by four bolts (349), a plunger or moving core (342), an operating rod (343), a stationary core (341) and a coil (347).

The operating rod (343) connects the moving core (342) to pin (227) Fig. 3 of the mechanism. It will be observed that an upward movement of this pin will cause the mechanism to close and latch the circuit breaker.

When coil (347) of the closing magnet is energized by contact of contactor the moving core (342) moves upward in response to the magnetic attraction between stationary and moving cores across air gap. About one-tenth of a second is required for the closing magnet to close and latch the circuit breaker. When the moving core moves into the "breaker closed" or "closed gap" position, arm (348) trips the contactor mechanically, and its contacts open, thus de-energizing the closing magnet. Arm (348) in moving up lifts trip rod (357) which rotates trip arm (356) against the force of spring (355). This rotation of trip arm (356) of closing coil contactor Fig. 5 and trips the contactor. The closing coil is momentarily rated and serious damage will result if potential is allowed to remain on its terminals through improper adjustment of trip screw (327) of close coil contactor Fig. 5 so that contactor does not trip and interrupt close coil circuit. When the moving core and operating arm have pushed the mechanism linkages to the closed and latched position, pin (227) holds the moving core in the "closed gap position".

When the mechanism is tripped pin (227) falls allowing operating arm and moving core to fall with it.

REPLACEMENTS

To replace the closing coil (347):

(a) Remove arm (348) by removing bolts (351).
(b) Remove plate (346) by removing four bolts (350).
(c) Remove coil leads and replace.

To replace spring (369):

(a) This spring may be replaced by removing snap ring from pin (358) and sliding trip arm (356) off.
(b) Contactor Fig. 5 must be removed from shelf first.

D-6. THE CLOSING COIL CONTACTOR

Reference Figure 5

FUNCTION

The closing coil contactor or control relay is used on electrically operated circuit breakers only and is mounted on the underside of the breaker shelf to the left of the closing magnet.

300	RELAY BASE	
301	MOVING CONT. ARM ASSY.	
*302	BLOWOUT MAGNET ASSY.	
*303	MOVING CONT. ASS'Y.	
*304	STAT. CONT. ASS'Y.	
305	FRAME	
306	STAT. CORE	
307	TERMINAL BRACKET	
308	RELEASE BRACKET	
309	COVER	
310	ARC CHAMBER	
311	TERM. CONN.	
*312	SPRING, CONTACT	
*313	SPRING, TRIP	
*314	SPRING, CONTACT ARM	
315	ELASTIC STOP NUT	
316	LATCH PIN	
317	RELEASE BRKT PIN	
318	1/4-20X5/8 SCREW	
319	.190-32X3/8 SCREW	
320	.190X1/4 BINDING HD. SCR.	

321	.164-32X3/8 PAN HD. SCR.	
322	.164-32X3/4 PAN HD. SCR.	
323	.190-32X1 3/8 PAN HD. SCR.	
324	.190 STD. WASHER	
325	.190 STD. LOCKWASHER	
326	.190-32 NUT	
327	SCREW	
328	SPRING WASHER	
329	CONTACT ARM PIN	
330	STRAP	
331	.190 STD WASHER	
332	JUMPER	
333	MOVING CORE	
*334	SPRING, LATCH	
335	PIN	
336	LATCH	
337	GUIDE TUBE	
*338	OPERATING COIL	
339	MOLDED SPOOL	

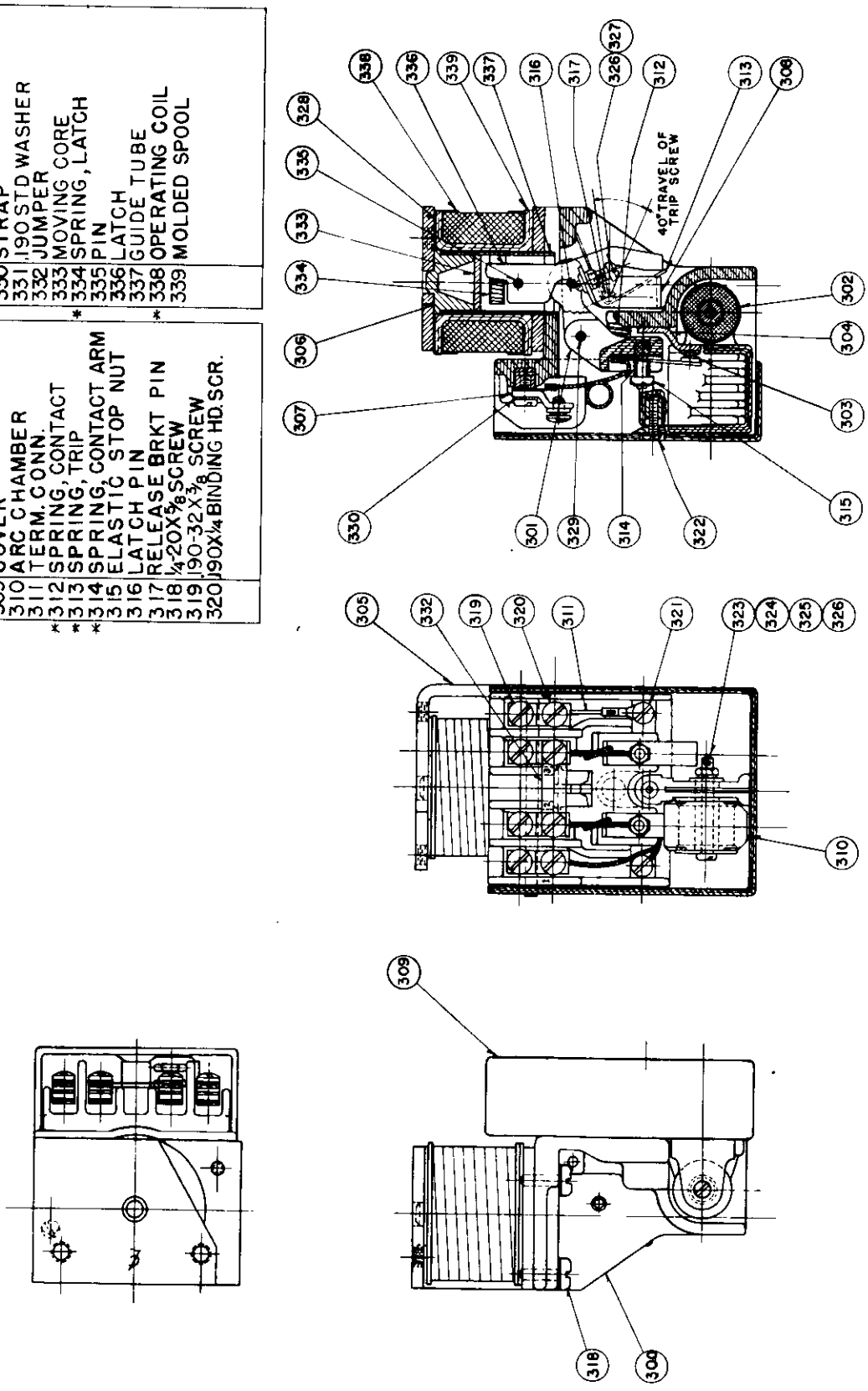


Figure 5 — Closing Coil Contactor (Relay)

The contactor has the function of closing and opening the closing coil circuit in electrical operation. Together with the shunt trip, the closing coil contactor enables the operator to control the circuit breaker electrically from a remote point by means of control switches.

DETAILED DESCRIPTION

The contactor consists of a base (300) molded from insulating material to which the contact assemblies, coil assembly, and other parts are attached. Frame (305) serves as part of the magnetic circuit of coil (338) and also serves to hold the coil in place. This frame or yoke is fastened to molded base by three screws (318) The coil (338) is wound on a molded spool (339) and is held in place by guide tube (337) which extends from the top of the molded base through the bottom of the frame (305) and through the center of the spool. At its upper end the guide tube (337) supports the stationary core (306) firmly in place against the frame. See Fig. 5.

The flat topped moving core (333) is free to slide up and down in the guide tube (337) and in moving up in response to the magnetic pull between the stationary and moving cores when the coil is energized pulls latch (336) which is fastened with pin (335) up with it. When the coil (338) is energized spring (334) bearing against latch (336) holds latch in such a position that it is hooked under latch pin (316) thus causing moving contact arm assembly (301) to rotate counterclockwise around contact arm pin (329) thereby compressing spring (312). The moving contacts (303) are thus pulled against the stationary contacts (304) completing the circuit. In Fig. 5 the moving core is shown in the upper or "contacts closed" position.

As soon as the contacts close, current starts flowing through the close coil of the circuit breaker and the moving core (348) of the closing magnet, Fig. 4, moves up, closing the circuit breaker. Trip bracket (353) fastened to moving core moves up with it and when the circuit breaker is almost closed the trip bracket (353) strikes trip screw (327) which is fastened to release bracket (308) thereby rotating bracket (308) counterclockwise around pin (317) against the torque exerted by torsion spring (313). When release bracket (308) is rotated in this manner, it strikes the bottom of latch (336), rotating it counterclockwise around pin (336) against the force of spring (334). This rotation of latch (336) causes it to become disengaged from latch pin (316) and consequently spring (312) extends causing moving contact assembly (301) to rotate clockwise thereby snapping moving contacts (303) away from stationary contacts (304) and interrupting the circuits.

With the circuit breaker in the closed position, trip bracket (353) Fig. 4 on the moving core of the closing magnet holds trip screw (327) of the contactor in the trip position. Therefore, even though the contactor coil may be inadvertently energized when the circuit breaker is latched, the contactor contacts will not close and no current will flow through the circuit breaker closing coil.

The moving contacts (303) are resiliently mounted by means of springs (314) around studs set into the moving contact arm (301) and are secured by elastic stop nuts (315). This causes a slight rolling and wiping action on the spherically shaped contact surfaces as they meet which helps to insure a positive electrical connection.

The contactor has a "seal-in" feature provided by the right hand contact which is connected in parallel with the control switch in the contactor coil circuit. This means that, once energized, the contactor will hold its contacts closed until it is tripped mechanically or until the contactor coil circuit is interrupted.

The left hand contact makes and interrupts the closing coil circuit. An arc chamber (310) molded from arc resisting material surrounds the left hand contacts. It is held in place by means of the two iron plates of the blowout magnet assembly (301) which in turn is fastened to the molded base (300) by means of screw (323). The blowout magnet coil is connected in series with the left hand contacts and consequently flux is flowing through the magnetic circuit and the air gap of the blowout magnet assembly at the time the contacts part and draw an arc. The magnetic circuit is so arranged that its air gap is across the arc chamber and the arc. The arc is forced by magnetic action down into the arc chamber where it goes out due to the stretching and cooling process. This arrangement makes possible a small and efficient contactor.

REPLACEMENT OF SPARE PARTS

DANGER!

Before working on the contactor, make sure that the circuit breaker is open and that the upper and lower studs are dead. Make sure that control circuits are dead. Realize that control wiring may be "hot" even though the main circuit breaker studs are dead.

Before replacing parts of the contactor, it is best to disconnect the wiring and remove it from the circuit breaker:

(a) Remove screw (322) and lift off molded cover (309) of the contactor thus exposing the four numbered terminals.
(b) Remove and tag the wires from the four terminals by loosening four screws (320).
(c) One lead from the contactor coil is connected to a terminal of the auxiliary switch. Remove front cover of the auxiliary switch, and disconnect lead.
(d) Remove the two screws through the circuit breaker shelf (152) Fig. 1 which hold the contactor to the shelf.

The contactor is now free from the circuit breaker.

To replace contactor coil:

(a) Remove three screws holding coil frame (305) to molded base (300) and remove from base.
(b) Pull out guide tube (337), allowing stationary core to drop out. Coil is now free to be replaced.

To replace latch spring (334):

(a) Remove frame (305) as before.
(b) Lift out moving core assembly (333).
(c) Rotate latch clockwise as far as it will go.

Spring will drop out. Replace.

To replace release bracket spring (308):

(a) Remove snap ring from one end of release bracket pin (317) and push pin out.
(b) Replace pin and new spring.

To replace moving contact arm assembly spring (312):

(a) Remove snap ring from one end of contact arm pin (329) and push pin out.
(b) This releases moving contact arm assembly (303) and spring (312) may then be replaced.

To replace moving contact (303) or contact spring (314):

(a) Remove elastic stop nut (315) and replace spring (if necessary).
(b) If a moving contact is to be replaced, disconnect its load from under the applicable terminal screw (319) and remove and replace.

To replace blowout magnet assembly:

(a) Remove leads of blowout coil.
(b) Remove screw (323) and replace blowout magnet assembly.

To replace stationary contact assembly:

(a) If left hand contact is to be removed, it will be necessary to remove blowout magnet assembly as outlined above.
(b) Remove the applicable screw (321) and replace contact.

D-7. ANTI-SHOCK-OPEN DEVICE

Reference Figure 6

FUNCTION

This device prevents tripping of the circuit breaker due to rotation of the trip lever caused by shock but allows normal rotation of the trip lever by tripping devices.

DESCRIPTION

The bracket (250) Fig. 6 is mounted on the supporting frame shelf to the immediate right of the operating mechanism frame (200) Fig. 1 and is held to the shelf by two screws (256). Plate (252) is pivoted on pin (253) as is lever (268). Lever and plate are connected by set screw (269) in such a way that if the trip bar rises, lever (268) rotates counterclockwise around pin (253) and plate (252) is caused to rotate in the same direction. Conversely, if plate (252) is restrained from rotating, trip bar is held down by lever (268). Under shock conditions, plate (252) is restrained from moving in the following manner:

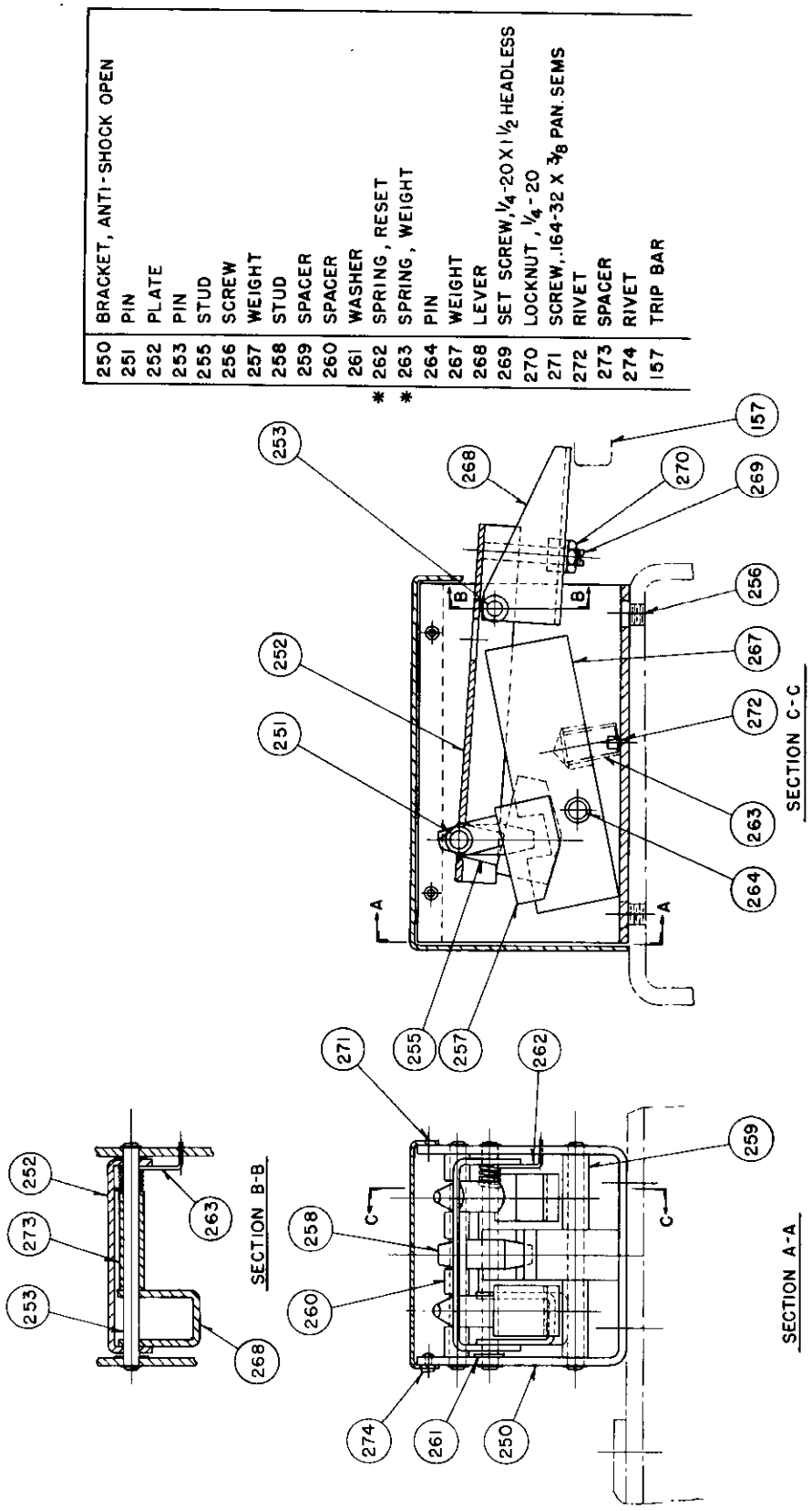


Figure 6 — Anti-Shock-Open Device

Studs (255) and (258) are suspended on pin (251) and plate (252) is fitted with a slot in its end arranged so that the plate will slide down and allow the circuit breaker to trip under normal tripping impulses. Under shock conditions, however, the two outboard studs are caused to rotate around pin (251) due to the off-center weights (257), thus jamming the plate (252) from sliding down. The middle stud is actuated by a separately pivoted weight (267) which rotates about pin (264). Spring (262) serves to hold weight in position shown during normal operation.

REPLACEMENTS

To replace reset spring (262):

(a) Remove cover screws (271) and cover.
(b) Remove device from shelf by removing screws (256).
(c) Removal of pin (253) will allow spring (262) to be replaced.

To replace weight spring (263):

(a) Repeat (a) and (b) above.
(b) Removal of pin (264) will free weight (267) and allow weight spring (262) to be replaced.

ADJUSTMENTS

With the device mounted on the breaker shelf, lever (268) should be adjusted by means of locknut (270) and set screw (269) so that it bears down slightly on trip bar (157).

D-8. SERIES OVERCURRENT TRIP DEVICE

Reference Figure 7

FUNCTION

This device trips the circuit breaker automatically under two distinct conditions of overcurrent. For overcurrents between 8,500 and 30,000 amperes, the circuit breaker will trip after a short time delay. For values of overcurrent greater than 30,000 amperes the circuit breaker will trip instantaneously. The time-current characteristic is shown in Fig. 8.

DESCRIPTION

The device consists of an electromagnet connected in series between the moving contact assembly of the pole unit and the lower stud. Under overcurrent conditions, tube assembly (440) rises, picks up trip screw, and trips the circuit breaker.

Tube assembly (440) is non-magnetic except for armature (455). Iron yoke (457) carries flux from bottom of armature (455) back to the top of the armature. When the overcurrent becomes high enough to exceed the calibration setting, armature (455) moves up pulling toggle and lever assembly (459) up with it by means of pin (472). Roller (464) bears an end ring (467) which in turn pushes tube up and trips the circuit breaker. Calibration springs (410) are connected to toggle and lever assembly through a system of linkages and serve to hold armature (455) down until the magnetic pull becomes great enough to extend them. Lever (459) is pivoted on pin (463) and connected through instantaneous spring (420) to gear segment (460) which operates pinion (474) and oscillator wheel (461) on the same shaft. Oscillator wheel is restrained from free rotation by oscillator (462). This restraining action gives short time delay.

With fault currents of greater magnitude than 30,000 amperes, instantaneous spring (420) extends and tube assembly (440) rises and trips the circuit breaker instantaneously, unimpeded by the mechanical escapement device.

ADJUSTMENTS

The scale plate (493) is marked for short time delay pickup at 8,500 amperes only. Adjusting knob (492) can be used to raise or lower the short time delay pickup point if desired. Moving the pointer down increases the pickup current and moving it up decreases the pickup current by increasing or decreasing tension in calibration springs (410).

REPLACEMENTS

To replace calibration springs (410):

(a) Remove bolts (451) and (478). This frees device from breaker.
(b) Remove insulation cover (484) by removing screws (475) and (495). Calibration springs (410) are now accessible for replacement.

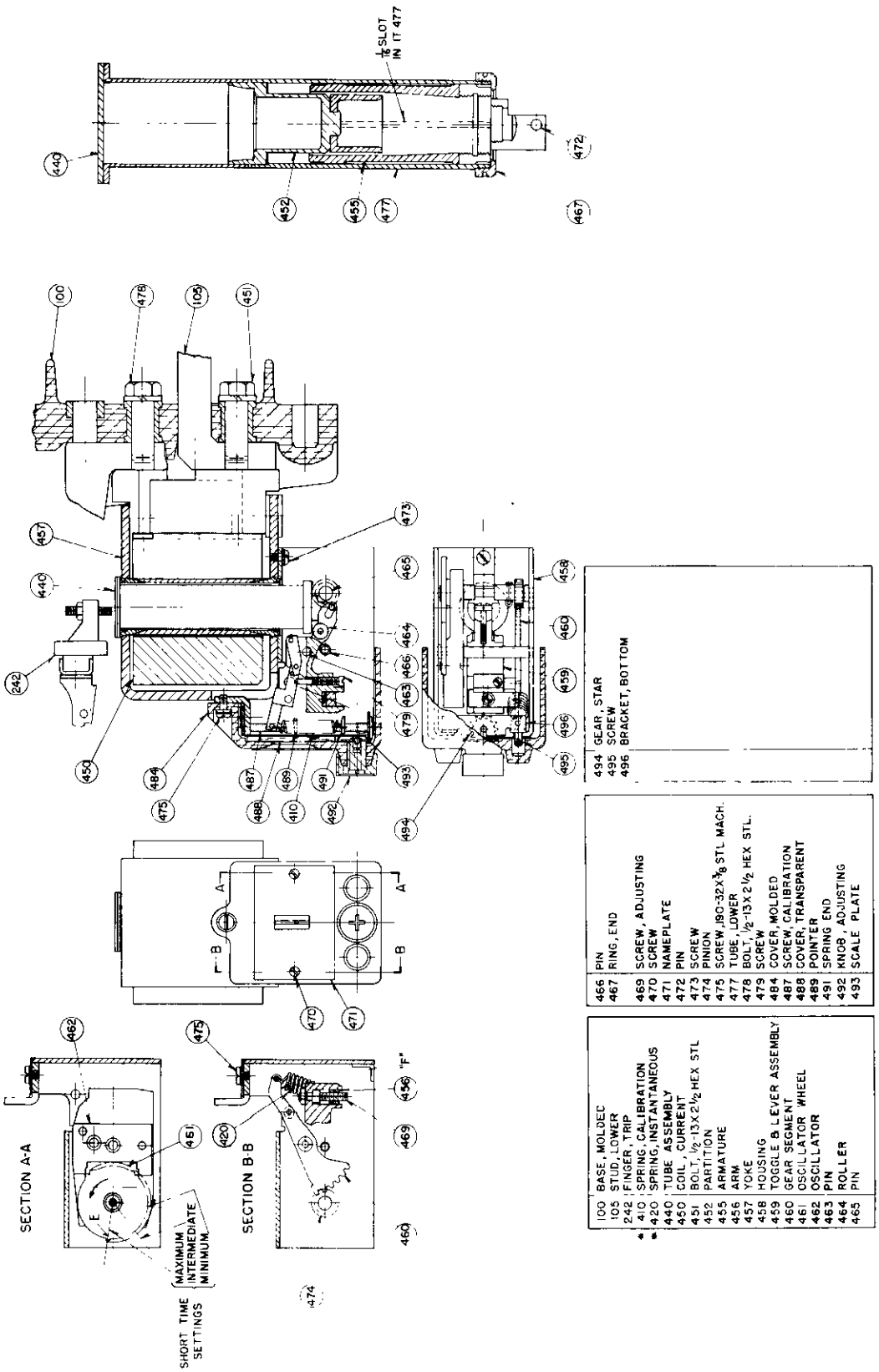


Figure 7—Series Overcurrent Trip Device

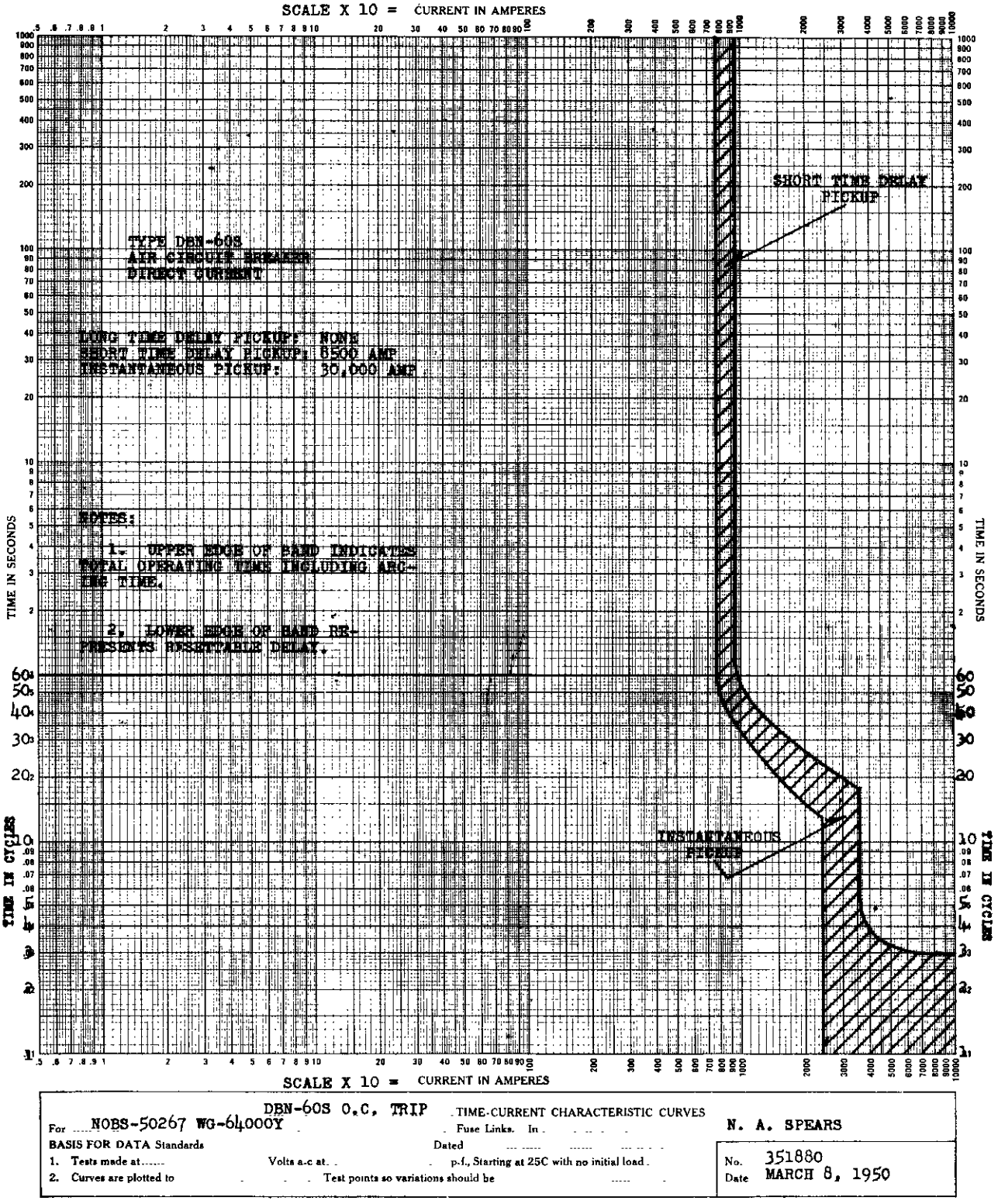

SCALE X 10 = CURRENT IN AMPERES
SHORT TIME DELAY PICKUP
TYPE DBN-60S
AIR CIRCUIT BREAKER
DIRECT CURRENT
LONG TIME DELAY PICKUP: NONE
SHORT TIME DELAY PICKUP: 6500 AMP
INSTANTANEOUS PICKUP: 30,000 AMP
NOTES:
1. UPPER EDGE OF BAND INDICATES TOTAL OPERATING TIME INCLUDING ARCING TIME.
2. LOWER EDGE OF BAND REPRESENTS RESETTABLE DELAY.
INSTANTANEOUS PICKUP
TIME IN SECONDS
TIME IN CYCLES
SCALE X 10 = CURRENT IN AMPERES
DBN-60S O.C. TRIP TIME-CURRENT CHARACTERISTIC CURVES
For NOBS-50267 WG-64000Y Fuse Links. In
BASIS FOR DATA Standards Dated
1. Tests made at Volts a-c at p-f., Starting at 25C with no initial load.
2. Curves are plotted to Test points so variations should be
N. A. SPEARS
No. 351880
Date MARCH 8, 1950

Figure 8 — Time vs Current Calibration Curve

To replace instantaneous spring (420):

(a) Repeat (a) and (b) above.
(b) Remove housing (458) from yoke (457) by removing screw (473).
(c) Spring (420) may be replaced by loosening adjusting screw (469). Arm (456) must be pin-pricked near the screw after replacement for locking purposes.

NOTE: Any field replacements on the overcurrent trip device should be regarded as temporary pending recalibration at the factory.

D-9. AUXILIARY SWITCH

Reference Figure 9

FUNCTION

The auxiliary switch is used to close or open auxiliary or control circuits. The closed or open positions of its sets of contacts are coordinated with the closed or open position of the main circuit breaker contacts.

DESCRIPTION

The four pole type RC auxiliary switch is mounted on the top of the supporting frame shelf to the left of the operating mechanism. It is operated by shaft (555) and arm (557) which connects to the breaker lever of the operating mechanism.

The contacts are designed to carry 15 amperes continuously or 250 amperes for three seconds.

The auxiliary switch is a shaft-operated, four pole, rotary type having three "a" and one "b" contact. An "a" contact is one that is open when the circuit breaker is open, and a "b" contact is one that is closed when the circuit breaker is open. Terminals 1-2, 3-4 and 5-6 are "a" contacts, and terminal 7-8 is a "b" contact.

A square shaft (555) extends through the rotor molds (560) which in turn isolate and support the rotor contacts (562). The rotor assembly is clamped together into a solid unit by screw (564). The rotor contacts are set 60^{o} apart for 60^{o} rotation of shaft (555).

Contact fingers (553) have one end hooked into stem (551) with spring (554) maintaining pressure between the finger contact and stem. The center of the contact finger bears against a stop surface in casing (550) to position the outer end of the contact finger.

REPLACEMENT OF AUXILIARY SWITCH

(a) Remove and tag the terminal connections.
(b) Disconnect link (557) from breaker lever, remove the two mounting bolts and remove switch.
(c) Remove link (557) from old switch and add to new switch.

D-10. SHUNT TRIP DEVICE

Reference Figure 10

FUNCTION

The shunt trip device serves as a means of tripping the circuit breaker from some remote point by the closing of a control switch or relay contacts at that remote point.

DESCRIPTION

The shunt trip device is mounted on the left side of the supporting frame shelf. See Fig. 1. It consists of a frame, coil and moving core mounted horizontally. Energizing trip coil (513) causes a magnetic attraction between stationary core (503) and moving core (504) which causes moving core (504) to move to the left rotating trip lever (501) about pin (502). Lever (501) raises trip bar (157) Fig. 1 to trip the circuit breaker. The opening of the circuit breaker de-energizes the shunt trip coil through an "a" contact of the auxiliary switch. Spring (508) returns moving core (504) to its normal position. Non-magnetic washer (510) prevents residual magnetism from holding the cores together when the coil is de-energized.

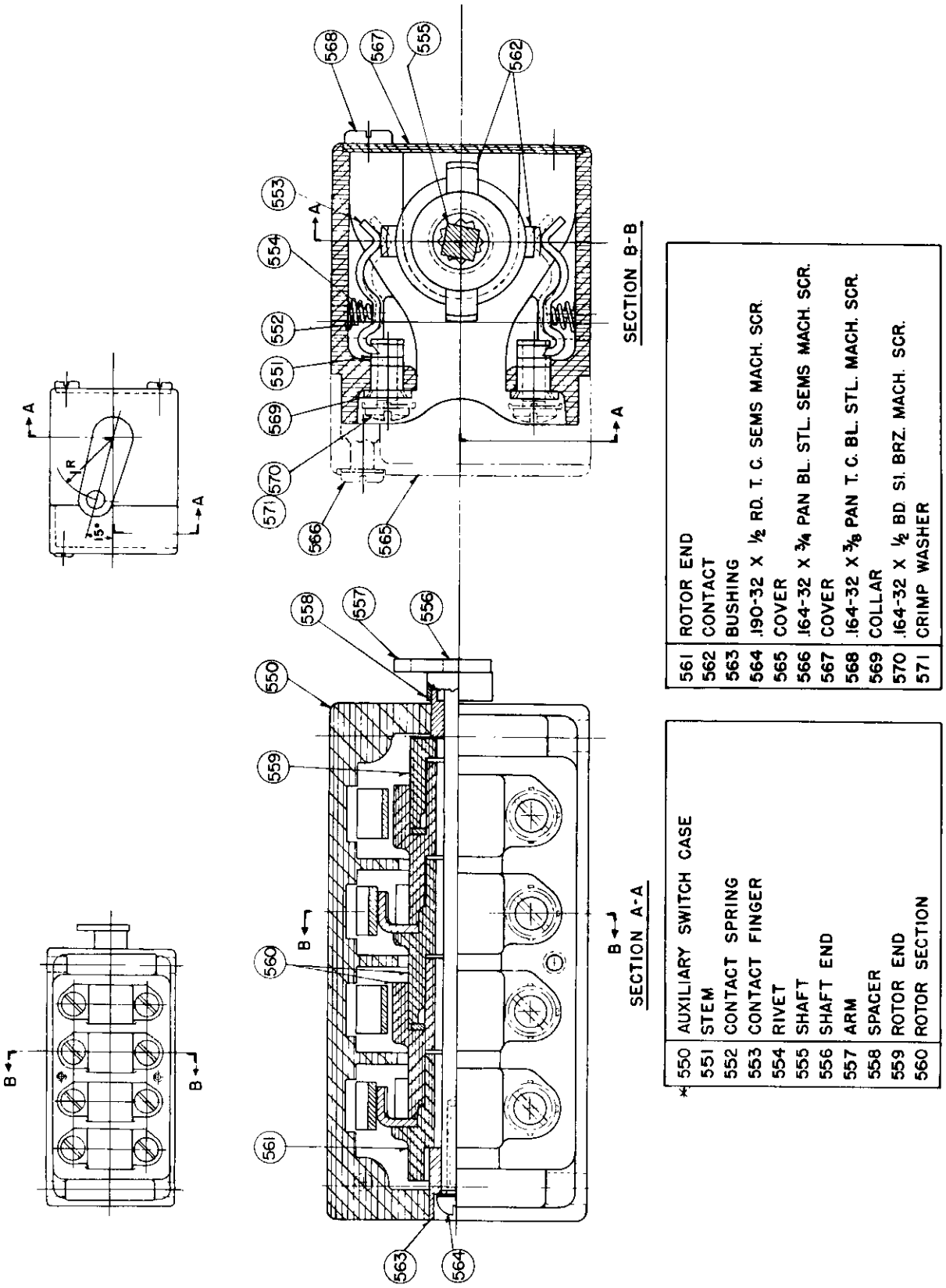
REPLACEMENTS

To replace coil (513):

(a) Disconnect the shunt trip leads from the auxiliary switch.
(b) Take out the two bolts (515) and remove the shunt trip assembly from the supporting frame.
(c) Remove pin (502) and screws (509) holding plate (505) in place and drop out the moving core (504), stationary core (503) and sleeve (507). The coil is then free to be replaced.

To replace spring (508):

(a) Repeat operations (a) and (b) above.
(b) Remove pin (502) and replace spring (508).



550	AUXILIARY SWITCH CASE
551	STEM
552	CONTACT SPRING
553	CONTACT FINGER
554	RIVET
555	SHAFT
556	SHAFT END
557	ARM
558	SPACER
559	ROTOR END
560	ROTOR SECTION
561	ROTOR END
562	CONTACT
563	BUSHING
564	.190-32 X ½ RD. T. C. SEMS MACH. SCR.
565	COVER
566	.164-32 X ¾ PAN BL. STL. SEMS MACH. SCR.
567	COVER
568	.164-32 X ⅜ PAN T. C. BL. STL. MACH. SCR.
569	COLLAR
570	.164-32 X ½ BD. SI. BRZ. MACH. SCR.
571	CRIMP WASHER

Figure 9 — Auxiliary Switch

500	SHUNT TRIP FRAME	
501	TRIP LEVER	
502	PIN	
503	STATIONARY CORE	
504	MOVING CORE	
505	PLATE	
506	BRACKET	
507	SLEEVE	
508	SPRING, RESET	*
509	SCREW	
510	WASHER	
511	BUSHING	
512	COIL SPOOL	
513	COIL	*
514	LEADS	
515	BOLTS	
157	TRIP BAR	

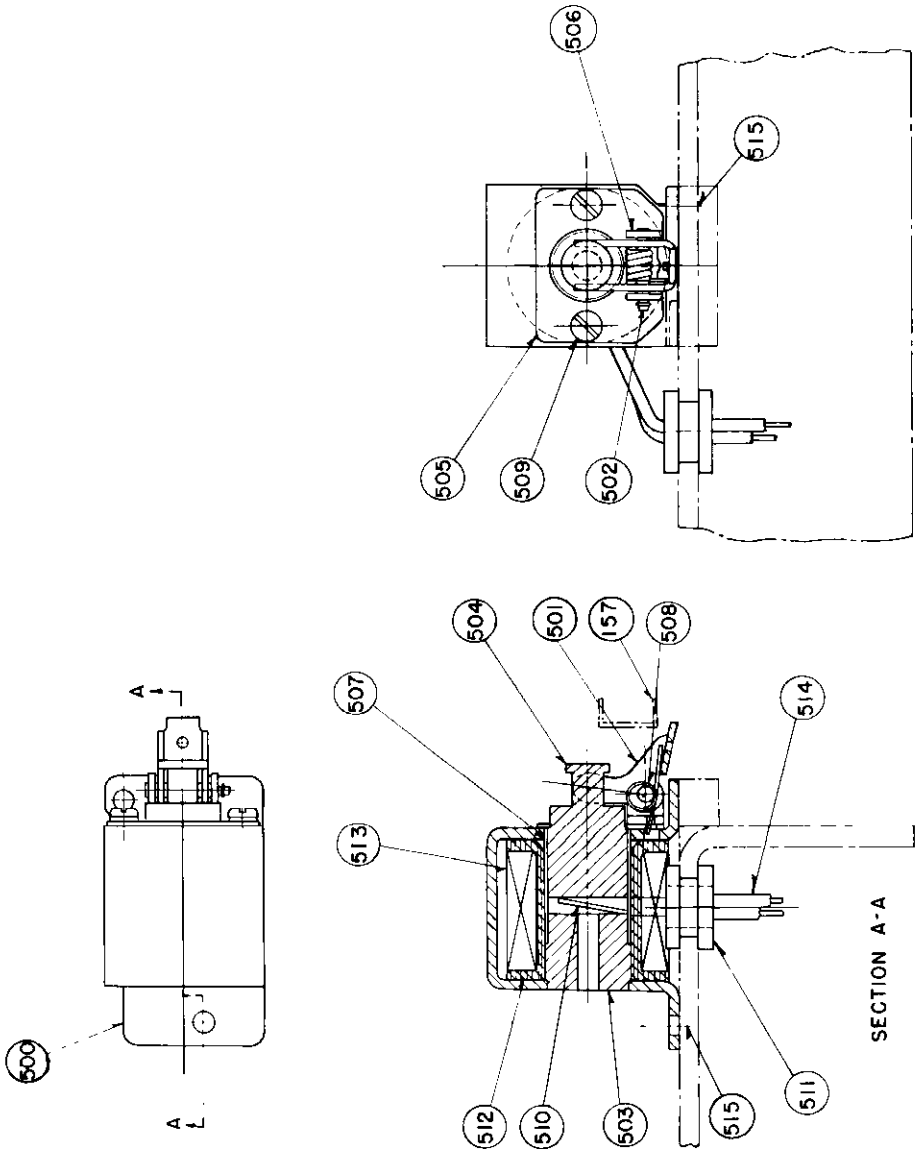


Figure 10 — Shunt Trip Device

SPARE PARTS LIST

Fig No.	Item No.	Name of Part	Mfr's Style No.	No. Installed Per Ship	No. Spares Per Ship
1	107	Spring, Remote Manual Trip	1589 253	4	1
2	118	Contact, Moving Arcing	1584 472	8	6
2	123	Contact, Stationary Arcing	1584 473	8	6
2	131	Spring, Accelerating	1584 468	16	3
2	182	Spring, Main Contact	1584 469	8	2
2	183	Spring, Bridge	1584 470	16	3
2	184	Spring, Arcing Contact	1584 471	8	2
3	215	Spring, Pawl	1581 956	4	2
3	223	Spring, Roller Latch	1584 519	4	1
3	233	Spring, Handle Return	1584 518	4	1
3	234	Spring, Trip	1584 517	4	1
7	262	Spring, Reset (A.-S. Open)	1584 521	4	1
7	263	Spring, Weight (A.-S. Open)	1584 522	4	1
1	264	Spring, Handle Stop	1584 516	4	1
6	302	Magnet, Blowout (Relay)	1491 288	4	2
6	303	Contact, Moving (Relay)	1491 294	8	2
6	304	Contact, Stationary R.H. (Relay)	1491 295	4	2
6	304	Contact, Stationary L.H. (Relay)	1491 296	4	2
6	312	Spring, Contact (Relay)	1491 306	8	2
6	313	Spring, Trip (Relay)	1533 822	4	1
6	314	Spring, Contact Arm (Relay)	1491 305	4	2
6	334	Spring, Latch (Relay)	1491 484	4	1
6	338	Coil (Relay)	1581 778	4	2
5	347	Coil (Solenoid)	1584 341	4	2
5	355	Spring, Relay Anti-Shock Trip	1584 396	4	1
4	369	Spring, Reset (A.-S. Close)	1574 792	4	1
8	410	Spring, Calibration (O.C.)	1574 796	16	3
8	420	Spring, Instantaneous (O.C.)	1584 812	8	2
11	508	Spring, Reset (Shunt Trip)	1491 282	4	1
11	513	Coil (Shunt Trip)	1581 779	4	2
10	550	Switch, Auxiliary	1581 958	4	2

NOTE: There Are Four Breakers Installed Per Ship